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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/096,858	06/12/1998	PRAVIN K. NARWANKAR	AMAT2571.US/	2295

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EXAMINER
MAI, ANH D

ART UNIT	PAPER NUMBER
2814	

DATE MAILED: 12/14/2001

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/096,858	NARWANKAR ET AL.	
	Examiner	Art Unit	
	Anh D. Mai	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 October 2001* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-29,31 and 33-45* is/are pending in the application.

4a) Of the above claim(s) *33-45* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-29 and 31* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

1. Claims 8-12 are rejected under 35 U.S.C. 102(e) for being clearly anticipated by Gealy et al. (U.S. Patent No. 6,082,375) as previously applied.

2. Claim 13 is rejected under 35 U.S.C. 103(a) for being unpatentable over Gealy '375, as applied to claim 8 above, and further in view Toshio (JP 04092423) as previously applied.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over G. B. Alers et al. "Nitrogen Plasma Annealing for Low Temperature Ta_2O_5 Films".

Alers teaches a method of forming a dielectric layer of a device as claimed including:

forming a dielectric layer on a substrate;

generating ionized atoms in a first chamber;

flowing the ionized atoms through a conduit coupling the first chamber to a second chamber, wherein the ionized atoms become electrically neutral active atomic species before reaching the second chamber; and

exposing the dielectric layer to the active atomic species in the second chamber; and

forming an electrode above the active atomic species exposed dielectric layer. (See PP. 1308-1310).

The conduit coupling of the remote plasma generator to the deposition chamber are well known. The ions generated by plasma are ionized. Further, since the active atomic species of Alers generate by remote down stream microwave plasma source, similar to that of the present invention, thus the ionized atoms of Alers also become electrically neutral active atomic species before reaching the second chamber.

With respect to claim 2, the active atomic species of Alers comprises reactive oxygen atoms.

With respect to claim 3, the active atomic species of Alers comprises reactive nitrogen atoms.

With respect to claim 4, the dielectric layer of Alers comprises a metal-oxide.

With respect to claim 5, the dielectric layer of Alers comprises transition metal dielectric.

With respect to claim 6, the dielectric layer of Alers comprises Ta_2O_5.

With respect to claim 7, the dielectric layer of Alers is exposed to the active atomic species while being heated to a temperature of less than 450 °C.

However, an in-situ densification of the metal oxide at the temperature below 400 °C was also performed.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to anneal the deposited oxide of Alers at the temperature below 400 °C since it is confirmed that in-situ densification at below 400 °C also found to have low leakage current.

4. Claims 8-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Alers et al. or T. Yasuda et al. "Low-Temperature Preparation of SiO_2/Si(100) Interfaces Using a Two-step Remote Plasma-Assisted Oxidation-deposition Process".

Alers or Yasuda teaches a method of forming a dielectric layer as claimed including:

generating a plasma comprising ionized atoms in a first chamber;

flowing the ionized atoms through a conduit coupling the first chamber to a second chamber, wherein the ionized atoms become electrically neutral active atomic species before reaching the second chamber; and

depositing a dielectric layer onto a substrate by CVD in the second chamber and while depositing the dielectric layer, providing the active atomic species into the second chamber.

The conduit coupling of the remote plasma generator to the deposition chamber are well known. The ions generated by plasma are ionized. Further, since the active or reactive atomic species of Alers or Yasuda generate by remote down stream microwave plasma source, similar to that of the present invention, thus the ionized atoms of Alers or Yasuda also become electrically neutral active atomic species before reaching the second chamber.

With respect to claim 9, the active atomic species of Alers or Yasuda comprises reactive oxygen atoms.

With respect to claim 10, the dielectric layer of Alers comprises a metal-oxide dielectric.

With respect to claim 11, the dielectric layer of Alers comprises transition metal dielectric.

With respect to claim 12, the dielectric layer of Alers comprises Ta_2O_5.

With respect to claim 13, the dielectric layer of Yasuda comprises a silicon-oxide.

5. Claims 14-19 and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Alers et al.

Alers teaches a method of annealing a deposited oxide as claimed including:

locating a substrate in a first chamber, the substrate having a deposited oxide formed thereon;

generating a plasma comprising ionized oxygen atoms in a second chamber;

flowing the ionized oxygen atoms from the second chamber into the first chamber through a conduit wherein the ionized atoms become electrically neutral reactive oxygen atom while flowing from the second chamber to the first chamber;

exposing the deposited oxide to the reactive oxygen atom; and

forming an electrode above the active atomic species exposed dielectric layer. (See PP. 1308-1310).

The conduit coupling of the remote plasma generator to the deposition chamber are well known. The ions generated by plasma are ionized. Further, since the active or reactive atomic species of Alers generate by remote down stream microwave plasma source, similar to that of the

present invention, thus the ionized atoms of Alers also become electrically neutral active atomic species before reaching the second chamber.

With respect to claim 15, the deposited oxide of Alers is exposed to the reactive oxygen atoms while heating the substrate to at a temperature of less than 450 °C.

However, an in-situ densification of the metal oxide at the temperature below 400 °C was also performed.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to anneal the deposited oxide of Alers at the temperature below 400 °C since it is confirmed that in-situ densification at below 400 °C also found to have low leakage current.

With respect to claim 16, the second chamber of Alers is a microwave applicator cavity of a remote plasma generator and is well known in the art.

With respect to claims 17 and 19, the reactive oxygen atoms of Alers appears to be formed by generating plasma from O_2 molecule utilizing microwaves.

With respect to claim 18, the reactive oxygen atoms of Alers is formed by generating plasma from N_2O molecule.

With respect to claim 21, the deposited oxide of Alers comprises a metal-oxide.

With respect to claim 22, the deposited oxide of Alers comprises transition metal oxide.

With respect to claim 23, the transition metal-oxide of Alers comprises Ta_2O_5.

6. Claims 13 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Alers et al., as applied to claims 8 and 14 above, and further in view Toshio (JP 04-092423).

Alers teaches all of the features of the claim with the exception of using silicon-oxide as the deposited oxide.

However, Toshio teaches forming a deposited oxide on a substrate comprising silicon-oxide.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to form the deposited oxide of Alers comprising silicon-oxide as taught by Toshio because silicon-oxide is also benefited from the ionized oxygen plasma treatment as well. Moreover, silicon oxide is a well known capacitor dielectric.

7. Claims 24, 28 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Alers et al.

Alers teaches a method of forming capacitor as claimed including:

forming a bottom electrode;

depositing a transition metal dielectric on the bottom electrode in a deposition chamber;

generating a plasma comprising ionized oxygen atoms by forming the plasma from an oxygen containing gas in a microwave applicator cavity in a remote plasma generator chamber;

flowing the ionized oxygen atoms through a conduit coupling the microwave applicator cavity and the deposition chamber, wherein the ionized atoms become electrically neutral reactive oxygen atoms before reaching the second chamber;

annealing the transition metal dielectric in the deposition chamber by exposing the transition metal dielectric to the reactive oxygen atoms; and

forming a top electrode above the reactive atomic species exposed transition metal dielectric. (See PP. 1308-1310).

The conduit coupling of the remote plasma generator to the deposition chamber are well known. The ions generated by plasma are ionized. Further, since the active or reactive atomic species of Alers generate by remote down stream microwave plasma source, similar to that of the present invention, thus the ionized atoms of Alers also become electrically neutral active atomic species before reaching the second chamber.

With respect to claim 28, the transition metal dielectric of Alers is deposited at a temperature within the claimed range.

With respect to claim 31, the transition metal dielectric of Alers is annealed at a temperature of less than 450 °C.

However, an in-situ densification of the metal oxide at the temperature below 400 °C was also performed.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to anneal the deposited oxide of Alers at the temperature below 400 °C since it is confirmed that in-situ densification at below 400 °C also found to have low leakage current.

8. Claims 25-27 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Alers as applied to claim 24 above, and further in view of Hasegawa '015.

Alers teach all of the features of the claim with the exception of explicitly disclosing the source gas utilizing for forming the transition metal dielectric (Ta_2O_5).

However, Hasegawa teaches forming the transition metal dielectric (22) utilizing source gases comprising TAETO, TAT-DMAE, O_2 and N_2O.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to form the transition metal dielectric (Ta_2O_5) of Alers utilizing the source gases as taught by Hasegawa since forming Ta_2O_5 utilizing theses gases are well known.

Response to Arguments

9. Applicant's arguments with respect to claims 1-7, 14-29 and 31 have been considered but are moot in view of the new ground(s) of rejection.

10. Applicant's arguments filed October 2, 2001, with respect to claims 8-13, have been fully considered but they are not persuasive.

Applicant appears to contend that Gealy does not teach providing active atomic species into a chamber ***while*** depositing a dielectric layer.

However, Gealy clearly teaches that such depositing is preferable conducted utilizing chemical vapor deposition ***with or without plasma***. (See col. 3, ll. 7-13). Gealy, further indicates that "[T]he invention was reduced to practice wherein the deposited material was Ta_2O_5, with atomic oxygen being provided.." (See col. 3, l. 45 to col. 4, 20).

Therefore, the process of Gealy can be simplified as: deposit/treatment with atomic oxygen, followed by etching then second treatment again with atomic oxygen; wherein plasma is generated remotely.

Gealy clearly teaches in-situ depositing the dielectric layer in the present of active atomic species (remote plasma).

The rejection of claim 8 and the dependent claims thereof are therefore, maintained.

Conclusion

11. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (703) 305-0575. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on (703) 306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

A.M
December 7, 2001

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